CLAIMS

What is claimed is:

1. A method for solenoid control comprising the following steps:

providing a freewheel circuit that includes a solenoid connected to a system power supply via a resistive shunt and a freewheel diode in parallel with the solenoid, the resistive shunt being included in a current-measuring circuit that measures current through the solenoid;

providing a current-control circuit comprising a differencing component, a power transistor and a switch device;

supplying a voltage pulse to the freewheel circuit by means of said power supply to reach a predetermined current level in said solenoid, and thereafter:

supplying pulsed voltage to said freewheel circuit by means of said current regulating circuit;

applying a measured result from the current-measuring circuit to the differencing component and thereby maintaining the supply by means of the current-regulating circuit for a certain time based upon the result of the measured result;

providing a voltage-control circuit comprising a second differencing component and having a structure similar to that of the current-control circuit;

connecting an input of the second differencing component to an output of the current control circuit;

applying into the freewheel circuit by means of the voltage-control circuit a control voltage of any value between 0 and a maximum supply voltage, thereby controlling the rate at which the current within the freewheel circuit decreases.

2. Method according to claim 1, further comprising detecting an irregularity in the decrease of the current in the solenoid during the controlled decrease of current and thereby determining when a core of the solenoid is being moved.

3. Method according to claim 2, in which the solenoid core moves a solenoid valve for fuel injection in a vehicle engine.

4. A circuit arrangement for controlling a solenoid that actuates a valve in a fuel-injection system, in which the solenoid is connected in parallel with a freewheel element comprising:

a current-control circuit operable to switch current through the solenoid between a pull-in level and a hold level; and

a voltage-control circuit applying a continuously adjustable voltage at a connection point between the solenoid and the current-control circuit such that the time it takes the current through the solenoid to drop from the pull-in level to the hold level is adjustable above a minimum time.

5. An arrangement as in claim 4, in which:

the current-control circuit includes an output transistor;

the solenoid is connected to ground over the output transistor of the current-control circuit; and

the connection point is electrically connected to an output point of the output transistor.

6. An arrangement as in claim 5, further comprising a current-measuring circuit having an output signal indicating the current through the solenoid, the current-measuring circuit including a resistive shunt connected electrically in series with the solenoid.

7. An arrangement as in claim 6, in which:

the output signal of the current-measuring circuit forms a first input to a differencing element in the current-control circuit;

a desired current level signal forms a second input to the differencing element in the current-control circuit;

the output of the differencing element in the current-control circuit corresponds to the difference between its first and second inputs and is applied as a driving input to the output element of the current-control circuit.

8. An arrangement as in claim 7, in which:

the voltage-control circuit includes an output transistor;

the solenoid is connected to ground over the output transistor of the voltage-control circuit.

9. An arrangement as in claim 8, in which:

an output signal of the voltage-measuring circuit, which is also the signal applied at the connection point, forms a first input to a differencing element in the voltage-control circuit;

a desired voltage level signal forms a second input to the differencing element in the voltage-control circuit;

the output of the differencing element in the voltage-control circuit corresponds to the difference between its first and second inputs and is applied as a driving input to the output element of the voltage-control circuit.

10. A circuit arrangement for controlling a solenoid that actuates a valve in a fuel-injection system, in which the solenoid is connected in parallel with a freewheel element comprising:

a current-control circuit operable to switch current through the solenoid between a pull-in level and a hold level;

a current-measuring circuit having an output signal indicating the current through the solenoid, the current-measuring circuit including a resistive shunt connected electrically in series with the solenoid;

and

a voltage-control circuit applying a continuously adjustable voltage at a connection point between the solenoid and the current-control circuit such that the time it takes the current through the solenoid to drop from the pull-in level to the hold level is adjustable above a minimum time;

in which:

the current-control circuit includes an output transistor;

the solenoid is connected to ground over the output transistor of the current-control circuit;

the connection point is electrically connected to an output point of the output transistor;

the output signal of the current-measuring circuit forms a first input to a differencing element in the current-control circuit;

a desired current level signal forms a second input to the differencing element in the current-control circuit;

the output of the differencing element in the current-control circuit corresponds to the difference between its first and second inputs and is applied as a driving input to the output element of the current-control circuit;

the voltage-control circuit includes an output transistor;

the solenoid is connected to ground over the output transistor of the voltage-control circuit;

an output signal of the voltage-measuring circuit, which is also the signal applied at the connection point, forms a first input to a differencing element in the voltage-control circuit;

a desired voltage level signal forms a second input to the differencing element in the voltage-control circuit; and

the output of the differencing element in the voltage-control circuit corresponds to the difference between its first and second inputs and is applied as a driving input to the output element of the voltage-control circuit.